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Evaluation of an Unlighted Swinging Airport Sign

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16 Abstract

An unlighted swinging airport sign was evaluated at the Federal Aviation Administration Technical Center. The purpose of the evaluation was to determine the readability of the sign under varying wind and jet blast conditions. Results indicate that the sign is readable under all of the test conditions except when subjected to wind speeds of approximately 35 to 40 knots with gusts produced by the additive effect of the ambient winds and the jet blast. Even under this condition, readability of the sign remained adequate except at the most extreme angular displacement.

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EXECUTIVE SUMMARY

Airport signs are very important pilot visual aids during the conduct of aircraft ground operations. Obviously, the signs must be clearly readable if they are to be effective.

An unlighted swinging airport sign is presently available that is designed to allow the sign face to swing between the mounting legs. Consequently, an evaluation was needed to determine if wind at various velocities or turbulence from jet blast will affect the readability of the sign.

The swinging sign evaluation was accomplished at the Federal Aviation Administration Technical Center. The 4- by 2-foot sign was installed on portable bases and located on the FAA ramp at the Atlantic City International Airport. While being subjected to various ambient wind/jet blast conditions, the sign was carefully viewed from various angles, distances and heights that simulated the view from the cockpits of small to medium general aviation aircraft.

Results indicate that the sign is readable under all of the test conditions except when subjected to wind speeds of approximately 35 to 40 knots with gusts produced by the additive effect of the ambient winds and the jet blast. Even under this condition, readability of the sign remained adequate except at the most extreme angular displacement.

INTRODUCTION

BACKGROUND.

Airport signs are very important pilot visual aids during the conduct of aircraft ground operations. These operations include taxiing, rollout, runway turnoff, and route guidance, particularly during crossings of runways and taxiways. Obviously, the signs must be clearly readable if they are to be effective.

An unlighted swinging airport sign is presently available that is designed to allow the sign face to swing between the mounting legs. Consequently, an evaluation was needed to determine if wind at various velocities or turbulence from jet blast would affect the readability of the sign.

PURPOSE.

The purpose of this project was to determine the swinging sign's readability and maximum degree of deflection from the vertical plane when subjected to:

1. Continuous wind, with and without gusts up to 50 percent of the wind velocity, at velocities ranging from 10 to 30 knots, blowing perpendicular to the sign face.

2. Turbulence from jet blast when the sign is located at a distance from the edge of the pavement in accordance with the criteria contained in advisory circular 150/5340-18C, Standards for Airport Sign Systems.

OBJECTIVE.

This effort was directed specifically toward determining the readability of the swinging sign when subjected to the wind and jet blast test conditions.

TEST PROCEDURES

All of the swinging sign testing was accomplished at the Federal Aviation Administration Technical Center. The 4- by 2-foot sign was installed on portable bases and located on the FAA ramp at the Atlantic City International Airport.

AMBIENT WIND EVALUATION.

The ambient wind test sessions consisted of evaluating the sign's behavior under wind speeds of 10 knots (figure 1) and 20 knots with gusts (figure 2). In both cases, the portable bases were positioned so that the wind would strike the sign directly perpendicular to the sign face. Wind speeds and directions were obtained several times during each test session via radio communications with the air traffic control tower.

The sign was viewed from several angles, distances, and heights that simulated the view from cockpits of small to medium general aviation aircraft. In addition, measurements were taken to determine the maximum degree of sign deflection from the vertical plane.

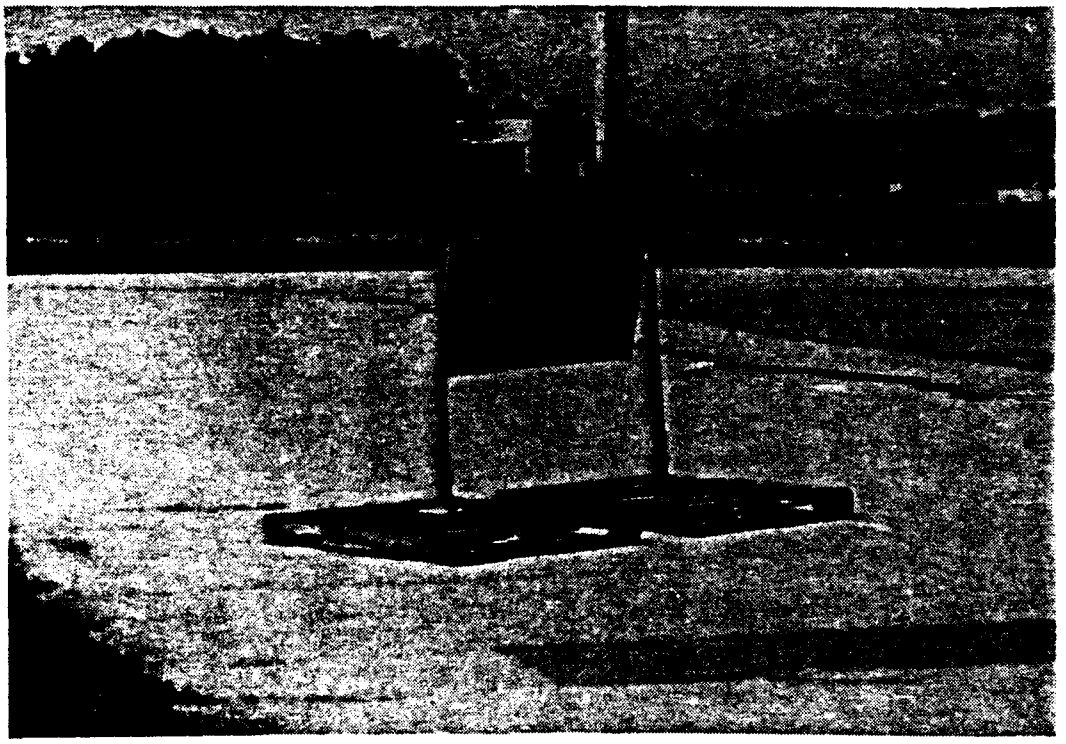

FIGURE 1. UNLIGHTED SWINGING AIRPORT SIGN - WIND SPEED 10 KNOTS

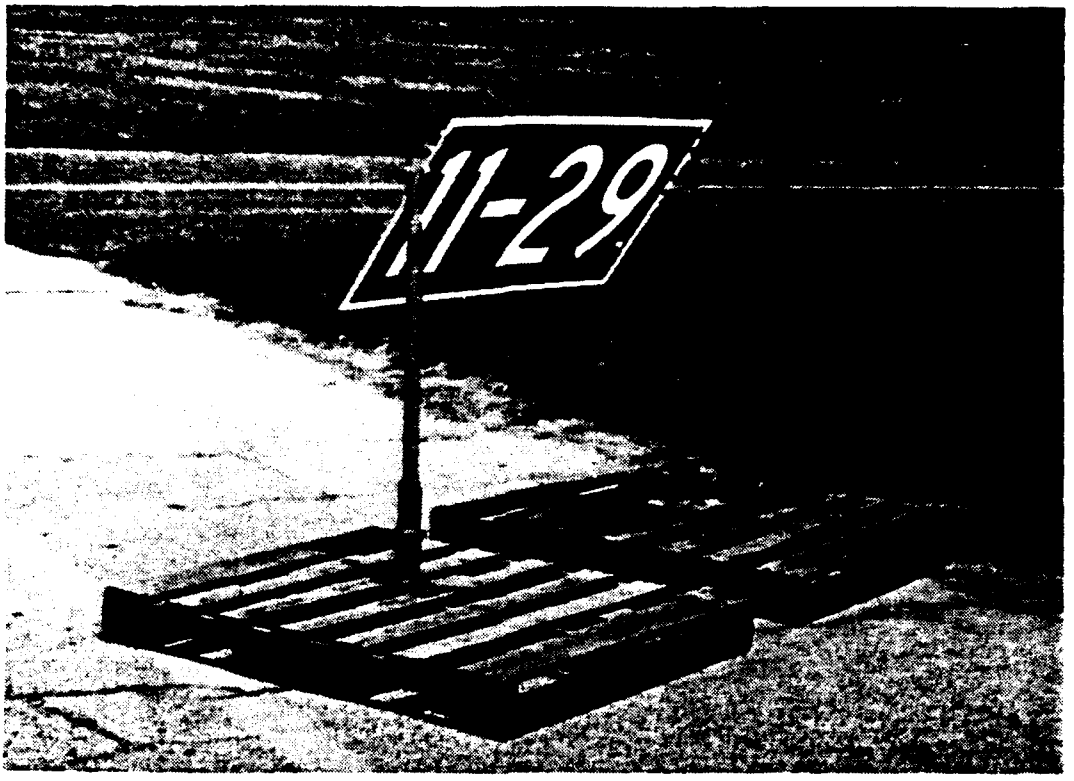

FIGURE 2. UNLIGHTED SWINGING AIRPORT SIGN - WIND SPEED 20 KNOTS WITH GUSTS

JET BLAST EVALUATION.

The jet blast evaluation consisted of two test scenarios. The purpose of the first test was to study the effects of, and deflection angles produced by a 35- to 40-knot wind with gusts on the sign (figure 3). These wind speeds were produced from the additive effect of the ambient winds and the jet blast of an FAA Boeing 727 positioned at a specified distance from the sign.

Due to the lack of ambient 30 knot wind velocities, and the unlikelihood of these wind speeds in the immediate future, no sign data were collected under these conditions. However, during the ambient wind evaluation, data were collected on the sign's behavior under wind speeds of 10 knots and 20 knots with gusts. This data, along with the 35- to 40-knot jet blast data provided for a very sound estimation of the sign's response to a steady 30 knot wind.

The second portion of the jet blast evaluation was designed to test the swinging sign's response to the B-727 as it taxied past the sign. The sign was positioned adjacent to the hold line on taxiway kilo and placed 20 feet from the edge in accordance with the criteria contained in advisory circular 150/5340-18C, Standards for Airport Sign Systems. Two passes, simulating turns from taxiway kilo onto a runway, were performed by the crew of the B-727. The first pass was made at normal taxiing power settings with the B-727 already at taxiing speed as it passed by the sign. The subsequent pass was accomplished with the B-727 initially holding on taxiway kilo adjacent to the sign. The turn onto the runway was then completed using a higher power setting, simulating the beginning of a rolling takeoff.

Throughout the jet blast evaluation the sign was viewed from several positions, and measurements were taken of the sign's deflection from the vertical plane.

FIGURE 3. UNLIGHTED SWINGING AIRPORT SIGN - JET BLAST EVALUATION

TEST RESULTS

AMBIENT WIND EVALUATION.

The sign's maximum angle of deflection from the vertical plane when subjected to ambient wind conditions of 10 knots and 20 knots with gusts are shown in figures 4 and 5, respectively. As illustrated in figure 4, the sign deflected 5 inches, which produced a deflection angle, D, of 16 degrees. As shown in figure 5, the sign deflected 10 inches, producing a deflection angle, D, of 33 degrees.

JET BLAST EVALUATION.

During this portion of the evaluation the sign was responding to wind speeds of approximately 35 to 40 knots with gusts produced by the additive effect of the ambient winds and the B-727 jet blast. Under these conditions, the sign's angle of deflection from the vertical plane varied from 38 degrees to a maximum of 63 degrees as shown in figures 6 and 7, respectively.

During the taxiing portion of the jet blast evaluation, the sign responded almost identically to both passes of the B-727. In each case, the sign responded to the taxiing aircraft by briefly swinging back and forth to an angle of approximately 60 to 70 degrees from vertical. The sign was displaced for only a very short period of time and quickly settled back to its original position. Any sign oscillations produced by the jet blast rapidly dampened out.

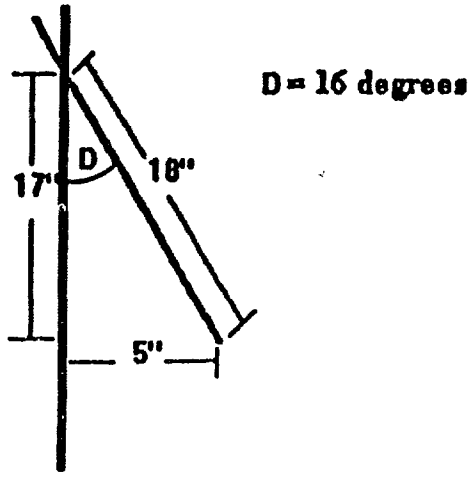

FIGURE 4. ANGULAR SIGN DEFLECTION - WIND SPEED 10 KNOTS

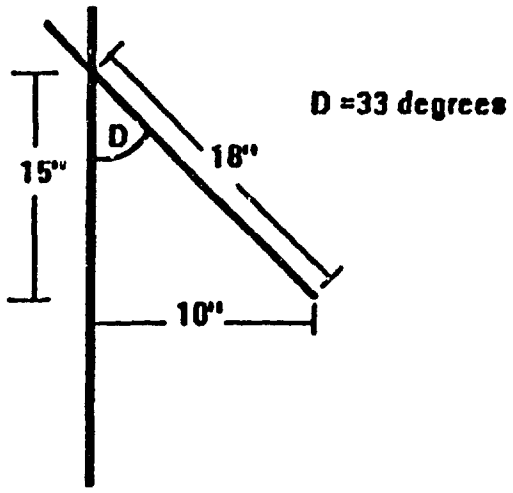

FIGURE 5. ANGULAR SIGN DEFLECTION - WIND SPEED 20 KNOTS WITH GUSTS

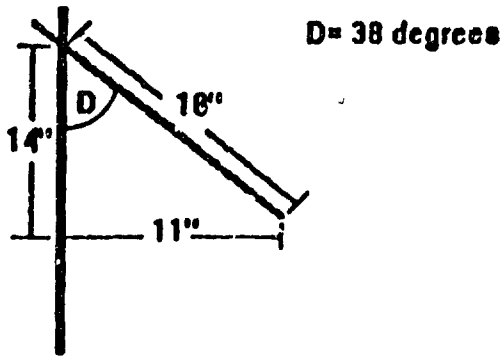

FIGURE 6. ANGULAR SIGN DEFLECTION - JET BLAST EVALUATION

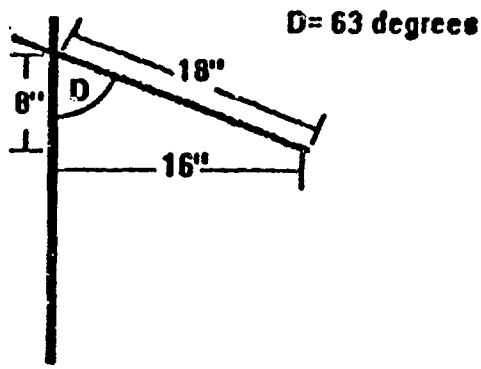

FIGURE 7. ANGULAR SIGN DEFLECTION - JET BLAST EVALUATION

CONCLUSIONS

During all phases of the evaluation, the sign was carefully viewed from various angles, distances, and heights that simulated the view from cockpits of small to medium general aviation aircraft. Based on these observations, the following conclusions can be reached.

1. The unlighted swinging airport sign is clearly readable when subjected to ambient wind conditions of 10 knots and 20 knots with gusts.

2. When subjected to wind speeds of approximately 35 to 40 knots with gusts produced by the additive effect of the ambient winds and the B-727 jet blast, the sign remained readable except at the most extreme angular displacement (approximately 65 degrees from the vertical plane).

3. Based on conclusions 1 and 2 it is reasonable to assume the sign should be readable in a steady 30-knot wind.

4. The unlighted swinging airport sign is clearly readable when subjected to the jet blast of the taxiing B-727 because the sign's design allows it to quickly return to its original position shortly after the aircraft passes by.

RECOMMENDATION

Based on the above conclusions, it is recommended that FAA Advisory Circular 150/5345-44F, Specification for Taxiway and Runway Signs, include a provision for an unlighted swinging airport sign for use at general aviation airports under wind speeds of 30 knots or less.